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WHY THE COAL TAR CHEMICAL INDUSTRY MUST BE PRESERVED

AND

HOW TO ACCOMPLISH IT

by

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"Was there ever such a complex, interdependent, indispensable industry since time began? No wonder the man without special training has difficulty in comprehending it! But he does know how to appreciate medicine when he is ill, recorded music when in the mood, the delicate perfume, the pleasing color combination, the need to be ready to defend all he holds dear. Why then can he not see the necessity of firmly establishing the sources of these vital products?"

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INTRODUCTION

THE question of the importance of the coal tar chemical industry to the wealth and welfare of the nation in time of peace and war, has been so fully discussed that it is hardly necessary to go into a lengthy explanation now. Every broad minded American, no matter what his or her political belief, has come to the conclusion that this industry must and will be safeguarded to the utmost, but in the layman's mind there is a question as to why extraordinary measures are necessary to protect and foster the industry. In view of this I have undertaken to describe as plainly as possible in a practical manner why most extraordinary precautions ARE necessary to assure ourselves that, broadly speaking, this industry is not going to be destroyed.

In order to acquaint the layman's mind with the intricacies of the industry it was necessary to describe in simple language the close connection between dyestuffs, drugs, explosives, photographic chemicals, perfumes, poison gases, tanning materials, synthetic resins, and so forth.

The importance of the different branches of the coal tar chemical industry and their interdependence is such that extraordinary care must be taken in devising ways and means not only to protect the industry, but to further develop it, and if this is to be accomplished, every safeguard must be provided.

Ways and means to protect and develop the industry can best be devised by men experienced in it and must not be left to those whose financial gain dictates opposition to the best methods of protection.

S. Isermann

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TABLE OF CONTENTS

Page

Phosgene, a Poisonous War Gas Utilized to Serve Mankind.... 3

The Relationship of the Dyestuff Industry to the Other Coal Tar Chemical Industries..... 6

Dyestuffs in Medicine..... 10

The Classification of Coal Tar Dyestuffs..... 11

Dyestuff Importations by Groups, Fiscal Year 1913-1914..... 17

Why an Ordinary Tariff Will Not Properly Protect the Dye and Coal Tar Chemical Industry..... 21

Selective Attack 25

Prices 25

Analysis of Dyestuff Patents..... 27

Letter of President Harding..... 29

Letter of Secretary Weeks..... 30

Letter of Secretary Denby..... 32

Letter of General Pershing..... 33

Statement of General Fries..... 34

A German Expert's View..... 37

Conclusion 41

Specimen Dyestuff Patent..... 42

Imports and Exports by Months..... 45

Utilization of By-Products..... 46

An English Expert's View..... 48

SEP 23 1921

PHOSGENE

A Poisonous War Gas Utilized to Serve Mankind

The World War and its impressions are still thoroughly in our minds. When one thinks of a poison gas he connects it with the horrors of warfare; that the same gas ever was, or is, going to be utilized to help mankind, is rarely known or understood. Usually it is thought that the development of poison gases should only be considered from the viewpoint of the preservation of the war powers in case of conflict. In view of this and in view of the coming discussion of the nations on the reduction of armament, or the disarmament conference, as it is called, the public press is full of the importance of the chemical industry to the national welfare and national defense. Every thinking American fully realizes the importance of the chemical industry to the welfare of the nation. Very few, however, give sufficient thought to the fact that the coal tar chemical industry which has played such a tremendous role in the late war, is one of the industries which was and will be utilized for the betterment, preservation and adornment of mankind.

To illustrate, one of the most important of all gases, "Phosgene Gas," destructive to the utmost on the one hand, is a constructive and beneficial agent of the highest value on the other. This gas, chemically called "Carbonyl Chloride," is one of the very useful agents in the arts and sciences. The importance of this gas as an agent of war, is hardly necessary to mention, but its importance on the industrial and beneficial side has been generally overlooked in the United States.

Dyes and Drugs

To set forth more clearly the several kinds of human endeavor in which Phosgene is of service, let us first consider it from the point of view as a constructive agent used in the manufacture of dyestuffs. As examples, let us take:

AURAMIN, a valuable popular yellow dye largely used in the dyeing of paper stock, highly prized in silk and cotton dyeing, is an offspring of Phosgene.

VICTORIA BLUE, another offspring of Phosgene, is a brilliant blue silk dye, a most popular shade with milady. During the War this dyestuff, owing to the unavailability of Phosgene for commercial purposes, was not obtainable on the markets.

WOOL GREEN S, one of a series of valuable dyes belonging to the Phosgene family. This dye is very highly regarded for wool and silk dyeing. The shade is popular in the form of ladies' shawls, sweaters, golfing jackets, etc.

These three examples ought to be sufficient to prove that Phosgene plays an important role in the manufacture of popular dyestuffs.

To introduce another phase of the usefulness of Phosgene, let us first describe the physiological action of Phosgene. It poisons the lung cells, makes respiration impossible, paralyzes the respiratory centers and produces a death of many agonies. To think that this same Phosgene, in conjunction with Guaiacol would be helpful in alleviating lung troubles, is beyond the conception of the layman; but the fact is that "Guaiacol Carbonate," a product of Phosgene and Guaiacol, a coal tar product, acts as a healer in lung troubles, and is usually employed in the different stages of tubercular infections.

Another example of the usefulness of Phosgene as a drug is "Carbozone," chemically known as Santalyl Carbonate, a useful drug for bladder trouble and urethral infections. This interesting drug, produced with the aid of Phosgene, is becoming very popular on account of its palatibility, compared with ordinary sandalwood oil. Other drugs, such as the popular but bad-tasting Quinine, can be made agreeable to take, by the proper use of Phosgene. This is accomplished without interfering with the effectiveness of the drug.

Flavors and Perfumes

COUMARIN, a very popular scent, is used for flavoring purposes and in perfumery. For many years produced by chemists from the coal tar derivative Phenol (Carbolic Acid) this is now being made with the aid of Phosgene. The largest consumers of this flavoring material in the United States are the tobacco and snuff manufacturers, and it is also used for making a certain grade of vanilla flavoring. Before the chemical body became popular, the Tonka Bean, which contains Coumarin, was largely used. Of late the synthetic coumarin has replaced almost entirely the Tonka Bean, and Phosgene, the poison gas, has simplified to a very great extent the methods of production of this most valuable of flavors.

Having spoken of the usefulness of Phosgene in the medical sciences and in the art of dyestuff making, let us now turn aside into a channel unlike those already touched upon, and for the moment let us appeal to the ladies of refinement through that discerning and delicate sense called Smell. It is said that to reach the lady's heart, "Say it with Flowers." There is no flower so generally acceptable or satisfying and so complete in itself as "The Modest Little Violet." True, it is a far step from the bloody fields of Flanders to the perfumer's laboratory, and yet this step can easily be taken and Phosgene makes this possible.

All perfume lovers will admit that perfumes are creations of fashions. Like fashions, they come and go. Odors have their seasons, their "rages," and then their courses are run. Numerous American or foreign bouquets which were the rage for a season have traveled into oblivion, but the Violet, the modest Violet, was, is, and always will be, the choice of the lady of refinement. But this is not all. We should add here that at no time was it possible to recreate the splendor of the natural fragrance of the violet as well as now. Why? Simply through the adoption of a chemical known as Phosgene.

METHYL HEPTIN CARBONATE. The name seems meaningless; true, but so was Phosgene until we knew something more about it. The chemical with the unpronounceable name to the layman, is a wonderful violet perfume body which was sold at prices so fabulous as to make one gasp for breath, even as one would after an inhalation of Phosgene! To be exact, this unpronounceable violet chemical body produced with the aid of Phosgene, not so very long ago sold in the markets of the world for several thousand dollars per pound. Since the chemist's skill in utilizing Phosgene to aid mankind has more fully been called into service, it is now being produced at prices such as to permit it to be used generally in the finer group of violet scents; and the lady, no matter how humble her station in life, can avail herself of the opportunity of having the finest and best American made violet perfume on her dressing table to enhance her charm and loveliness.

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THE RELATIONSHIP OF THE DYESTUFF INDUSTRY to THE OTHER COAL TAR CHEMICAL INDUSTRIES

The best known coal tar crudes, distilled from coal-tar, are BENZOL, TOLUOL, XYLOL, PHENOL, CRESOL, NAPHTHALENE and ANTHRACENE. These are of themselves pure products, but are called "crudes" because they are the raw materials for the manufacture of "intermediates." Intermediates are the raw materials for the production of the numerous finished synthetic organic chemicals of coal-tar origin.

BENZOL

BENZOL is the base for ANILINE OIL, which coal tar product was at one time the only base for ANILINE DYES.

While today it is very seldom used in the same manner and for the same purposes as it was fifty years ago when the dyestuff industry started, new processes and methods have been invented in which ANILINE OIL is used, and, therefore, it is still the most largely consumed intermediate product used in the manufacture of dyestuffs.

It is for this reason that the coal tar dyes have retained the name ANILINE DYES.

From BENZOL is made PICRIC ACID, an explosive, and CHLOR PICRIN, a very important poison gas; also HYDROQUINONE, the largest and most important photographic developer, especially for moving pictures, etc. ANILINE OIL is also the base for SALVARSAN, a drug of utmost importance to the health and welfare of the nation. Another important use occurs in the manufacture of rubber goods, such as tires and rubber sundries, where ANILINE OIL is employed as an accelerator, in the process of curing. At the beginning of the War when there was a shortage of aniline oil, all the large rubber manufacturers installed their own aniline oil plants. ANILINE OIL is used for producing a GERANIUM PERFUME and for the manufacture of stabilizers for gun powder. From ANILINE is also made TETRA NITRO ANILINE, a very high explosive known as TETRYL.

TOLUOL

One of the important intermediates made from TOLUOL is BENZYL CHLORIDE, which is used for the manufacture of:

BENZALDEHYDE, a flavoring material out of which is also made a SYNTHETIC HYACINTH PERFUME, and a variety of most important GREEN and BLUE ACID DYES.

BENZOIC ACID (Benzoate of Soda), a drug and preservative.

BENZYL BENZOATE is a chemical substance belonging to the Benzoic Acid group and is so intensely interesting that a word about it will not be amiss. This colorless oily body was first brought into prominence as a solvent by perfumers. During the War its usefulness became known in connection with the construction of aeroplanes, to render the wings fire and waterproof. "But this is not all." About 1918 an American scientist of Johns Hopkins University discovered its use in medicine. *He found that Benzyl Benzoate has the same pain-allaying properties as some of the constituents found in opium but it is non-habit forming and has none of the narcotic qualities of opium.* In two short years this American discovery is largely prescribed for its almost specified action in such conditions as asthma, for irritating coughs like "whooping" cough, etc. *Here is an illustration of a simple organic chemical substance which can serve mankind at one time as a valuable solvent, a weapon of warfare and a useful drug.*

BENZYL CYANIDE, an intermediate for the manufacture of poison gas, known as BROM BENZYL CYANIDE.

From PHENYL ACETIC ACID (made from Benzyl Cyanide) is made PHENYL ETHYL ALCOHOL, which is at the same time a rose leaf perfume and one of the newest local anesthetics for minor surgery. It is also the starting point for newly adopted antiseptics.

BENZYL CHLORIDE is an important intermediate for the manufacture of ACID GREENS, ACID VIOLET, ACID BLUES, and other very important dyestuffs. From TOLUOL are also made hundreds of other valuable dyestuffs, and COLOR LAKES.

TRINITROTOLUOL (commonly known as T. N. T.) one of the most important explosives, used largely during the war by all countries and having replaced PICRIC ACID to a very great extent because it is safer to pack and ship. A sweetening material and flavor known as SACCHARINE is also made from TOLUOL.

PHENOL

This product is found by itself in coal tar, or it may be made synthetically from BENZOL. It was one of the first important disinfectants and was introduced under the name of CARBOLIC

ACID. The same PHENOL or CARBOLIC ACID is used for the production of ACET PHENETIDIN (phenacetine, a headache remedy and antipyretic), a very important drug, PICRIC ACID, an explosive, SALICYLIC ACID, a base for numerous drugs, as for instance, ASPIRIN. SALICYLIC ACID is also used for a great number of dyes, as for instance CHROME BLACKS, ACID and DIRECT REDS, YELLOWS, BLUES, for men's wear. A great number of important SULPHUR COLORS are made from PHENOL.

Other products produced from PHENOL are COUMARIN, an important flavor, PARA AMIDOPHENOL, a fur dye and a photographic developer, METOL, the best and most popular photographic developer, DIPHENYL OXIDE, an artificial GERANIUM PERFUME. A great number of other dyes, drugs and organic chemicals, are obtained directly or indirectly from PHENOL. As a matter of fact, there are a greater number of drugs produced from PHENOL than any other coal tar chemical, as even GUAIACOL, which was originally obtained from beechwood, is now being made from PHENOL. In turn, this product may be used for the production of VANILLIN, an important flavor and perfume. It also is commonly used for the manufacture of synthetic, insulating material, such as BAKELITE, REDMANOL, CONDENSITE, etc., and for the manufacture of phonographic records. To describe the varied and many uses of PHENOL would consume many pages.

NAPHTHALENE

A coal tar crude used in the manufacture of DIRECT COTTON and ACID WOOL and SILK DYES.

A very important product made from NAPHTHALENE is,

BETA NAPHTHOL, used as a drug, as BETA NAPHTHOL BENZOATE and similar compounds; it is also used for developing fast colors on cotton and as a base for LAKES used for printing.

In conjunction with PARA NITRANILINE as a red it is used largely in paper printing and for color lakes.

The NAPHTHALENE series is probably the most important series of dyes, as from NAPHTHALENE is made PHTHALIC ANHYDRIDE, a starting point for the manufacture of INDIGO and an entire series of INDIGO and ALIZARIN COLORS, which have a promising future.

NAPHTHALENE is used for the manufacture of PHENOLPHTHALEIN, a drug (a mild laxative), and an indispensable indicator for chemical reactions.

DIETHYL PHTHALATE, a solvent for the perfumery trade. It is also used for the manufacture of ARTIFICIAL LEATHER and in the production of INSULATING MATERIALS for MOTORS, etc.

TRINITRONAPHTHALENE, a very important explosive.

ETHYL and METHYL BETA NAPHTHOL, which are ORANGE PERFUMES.

XYLOL

This coal tar crude is used for the manufacture of a considerable number of important dyestuffs, principally REDS, SCARLETS, BLUES and GREENS. Quite a number of important COLOR LAKES are produced from it.

Aside from its use for the manufacture of dyestuffs, Xylol has found but very few usages. During the war, however, a product of XYLOL, TRINITROXYLOL, was introduced as an important HIGH EXPLOSIVE. Had the war continued for any length of time, TRINITROXYLOL would have been employed to great advantage. There are also dyes made from Xylol which are used for INDICATORS. Furthermore, an ARTIFICIAL MUSK is also being manufactured out of XYLOL, which product is very closely related to the explosive TRINITROXYLOL.

This will give an approximate idea of the number of chemical products that have been made out of the COAL TAR CRUDES. There are other coal tar crudes out of which a great number of useful products are made. As a matter of fact, thousands of coal tar chemicals in the way of drugs, dyes, photographic materials, flavors, perfume materials, insulating materials, tanning materials, synthetic resins, and other similar chemicals have been made and probably will be made in the near future. To describe fully all the possibilities would take up more space and consume more time than is at your disposal, but this ought to give an approximate idea of the possibilities, and will show the close relationship that exists between the coal tar dyes and all the rest of the related chemicals, and will prove the contention that unless the entire and complete field is properly protected we will never have a substantial coal tar industry in this country or become independent of the rest of the world.

DYESTUFFS IN MEDICINE

Many investigators of chemical structures of organic chemical bodies, whether of plant, animal or artificial origin, studied the relation between the chemical constitution and physiological action of these and allied substances.

In this way Methylene Blue, a basic dyestuff, was experimented with and found to possess strong parasiticidal action—it is used internally in nephritis and rheumatism and relapsing fevers. In like fashion two Benzidine dyes made for cotton dyeing were found Trypanocidal, highly useful in treating tropical diseases—notably the sleeping sickness. These two are—the Trypan Red and Trypan-Blue.

Malachite Green and Brilliant Green, dyestuffs of coal tar origin, were used extensively as antiseptics. Scarlet Red, a Toluol dye, was found to stimulate growth of tissue over granulating wounds.

The Arsphenamines or Arsenobenzols, or Salvarsans, or simply "606," belong to the class of dyes useful as a specific remedy for syphilis in all stages. This notable drug is produced from Benzol and it contains about 31% of Arsenic which is so combined that it destroys the parasites (serving as food for the parasites) without exerting its toxic effect on the human organism. It is useful in all tabetic affections, early paralysis and in epilepsy due to syphilis.

No less notable dyestuffs used in medicine are the two Acridines —intense yellow dyes. Proflavine and Acriflavine, both possessors of high antiseptic power, which in the process of wound repair have no deleterious effect on either the leucocytes (white blood corpuscles) or phagocytes. This desirable quality is possessed by no other antiseptic. Both these antiseptics are non-toxic and non-irritating. The greatest popularity of the Flavine antiseptics dates since the World War where their employment in gun-shot wounds brought them into prominence.

All these useful bodies are made in America and the industry contributing these health agents is the same which contributes other dyestuffs, colors, drugs, photographic materials, flavors, perfumes, solvents, artificial silk, artificial leather, ivory resins, rubber and other useful commodities.

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THE CLASSIFICATION OF COAL TAR DYESTUFFS

Dyestuffs are usually classified into six groups, which grouping has no bearing on their method of manufacture, as there are hundreds or thousands of methods of manufacturing the known dyestuffs, but this grouping has a direct bearing on the practical side of dyestuffs, which is their method of application and their usage. The groups are:

(1) BASIC DYES,
(2) ACID DYES,
(3) DIRECT DYES,
(4) CHROME AND ALIZARIN DYES.
(5) VATS AND INDIGO DYES,
(6) SULPHUR DYES.

(1) BASIC DYES. Basic Dyes are the dyes which were first discovered in England and from 1860 to 1870 developed in France, and from then on further developed in Germany. They produce shades of wonderful brightness, but very poor fastness to light, and their use, while being still quite large on account of their brightness has been displaced of late with dyes faster to light belonging to the acid group or the direct group.

The Basic Dyes dye wool and silk in a water bath, without any additions whatsoever; cotton, however, to be dyed with them, has to be treated first with tannin (Tannic Acid).

Basic Dyes still find considerable use in the manufacture of printing inks.

(2) ACID DYES. This group of dyes is known under the name of acid dyes, as an acid has to be used in the dye bath to properly develop the dye on the fiber. Their principal use is on wool or silk fiber and for light material, such as ladies' dress goods, knitting yarns, etc., which do not stand much handling due to the flimsy construction or character of the material, and the dyeing with acid dyes can be done in a very short time and by a single process. Their use on cotton, however, is very limited.

The relative value of acid dyes against other dyes depends: first, on their property of easily dyeing the material level (which

means that a dye goes on the fabric or yarn evenly and does not streak); second, their relative fastness to light; third, their relative fastness to alkali, which is contained in street dust.

All acid dyes do not possess all of the same properties, some produce shades which are faster to light than others, some produce shades which are faster to alkali than others, while some of the fastest dyes are of little use on account of their uneven dyeing properties and dullness of shade, and very often, a very bright dye is used for brightening up dull shades, even though the fastness to light be not all that is desired.

On the whole, there are hundreds of this class of dyes in use and there are several thousand more known, which may or can be used.

Speaking, however, from the practical or dyers' point of view, one-half or three-quarters of the acid dyes may be done away with without interfering with the shades in demand from season to season.

As a practical proposition most of the new dyes, which have been introduced in the past fifteen years, were of no real advantage to the dyer but served the purpose of offering a good sales argument for replacing the dyes of one concern with those of another of Germany or Switzerland.

Fastness to light in a great many cases is not of such great importance, as acid dyes are used most on women's dress goods and such fancy goods where the main object is brightness and brilliancy of shade and which are not intended for constant use in direct sunlight.

As quite a percentage of acid dyes is used for dyeing evening wear articles, the fastness to light, that is to sunlight, often becomes of secondary importance. More often, the property of retaining the same shade in artificial light is more desirable than the fastness to sunlight. Many dyes are peculiar in that, under artificial light, the shade of the dyed fiber appears different than in sunlight.

The acid dyes made in the U. S. A. are every bit as good and bright as their corresponding dyes of foreign origin.

The production of the large number of what may be called unnecessary dyes developed, however, chemical experience, refine-

ment of equipment, and knowledge of manufacturing to a great extent.

(3) DIRECT DYES. Direct dyes derive their name from their property of dyeing either cotton, wool or silk in a direct dye bath without the addition of any chemicals. Their principal use is for cheap cotton goods and cotton worsteds, for which latter material they are often sold under the name of Union Dyes.

The fastness of the earlier direct dyes is not as good as may be expected, but their easy method of application and their reasonablness of price made them very desirable, and for that reason very large amounts have been imported and similar dyes are now being made here on a very large scale.

The methods of production (or assembling) which were also carried on in the U. S. A. on a small scale previous to the war were very simple and did not take much complicated machinery, although the production of the raw materials or intermediates for these dyes requires considerable chemical skill and equipment.

The average direct dye does not produce shades on cotton fast to washing. Therefore methods of after treatment are used on many dyes. The principal method is called "Developing," which means the dyestuff is changed on the fiber by the addition of intermediates to the dye bath, and which produces shades very fast to washing and light and was used prior to the war by most hosiery mills for blacks, blues and browns.

These developed dyes were the ones which became very scarce a short while after the outbreak of the European War and the hosiery dyers were placed in a position where they had to use direct cotton dyes of poor fastness to washing. This caused considerable dissatisfaction, both in the trade and with the consumer, especially the buyer of hosiery.

At the present time a great many of these developed dyes, especially blacks, are manufactured here on a large scale. These dyes are of equal fastness and quality with the foreign developed dyes, but some hosiery manufacturers having become used to the single process of dyeing during the war are not inclined to change back to the more complicated method of developing.

The American dyestuff industry is suffering on this account, and many complaints from the man in the street that cotton dyes are not fast are obviously due to the fact that the proper dyes are not used.

(4) CHROME AND ALIZARIN DYES. While Chrome and Alizarine Dyes are of quite different chemical composition, each from the other, their uses and methods of application are similar. Therefore they are almost always classified together.

(4-a) CHROME DYES. Chrome Dyes are almost invariably such acid dyes, which, either by after treatment with metallic salts, such as chrome, or by treating the wool before dyeing with metallic salts, change their original shades into shades of different hues and greater fastness both to light and a process known as fulling.

Fulling is a very essential process in the manufacture of woolen cloth, the cloth being woven in a width of 80 inches and more at times, and this width shrunk by the use of alkaline soaps to 56 inches in the Fulling Mills, which adds of course to the thickness and wearing strength of such material.

This type of dye is highly perfected in this country and few if any need to be imported at this time to satisfy the average demand from season to season.

(4-b) ALIZARIN DYES. Alizarin dyes are usually derivatives of Anthracene. This type of dye may be called the latest development in acid chrome dyes.

In reality, it was just a few years prior to 1914 that these dyes became popular.

The advantages of these dyes are their great fastness to light in even very light shades such as greys and tans, and their fastness to Fulling, and for those reasons they are especially used for the dyeing of men's wear.

There are several concerns in this country who are now successfully making some of these dyes, but additional time is necessary to further develop this group of dyes.

(5) VAT DYES AND INDIGO. Vat colors take their name from the fact that they are dyed in large volumes of water, small quantities of material being dyed only at one time in a large tank or vat. The reason that the word vat is used is that most all other dyes are dyed at the boiling point of the dye bath in a kettle called Dye Kettle, while Vat dyes are dyed at a temperature of about 120 degrees Fahrenheit and are never boiled.

The oldest vat dye known is indigo, which has been made synthetically for the last twenty years and is now being made here in sufficient quantities to supply all demands.

In poundage, indigo is still the biggest single dye in use by the textile industry.

Within the past fifteen years, other vat dyes of great fastness, similar to indigo, have been introduced in the market with more or less success by the Germans and others.

If one considers poundage, vat dyes other than indigo would play but a small role except for their peculiar fastness properties. These vat dyes are especially fast to washing and chloring (bleaching) and are therefore used especially for wash goods materials, such as shirtings, etc., and though the quantities consumed may be small they are nevertheless of great importance.

The development of this class of dyes has made very considerable progress within the past year in this country and there are now several makers of this group of dyes, producing a considerable line.

Their manufacture, however, requires extraordinary skill, special and expensive facilities, and a great deal of research. For that reason it is important that this group of dyes be protected to allow the proper development.

If we are going to have a coal tar chemical industry here, we ought to have a hundred per cent industry, as it is in that way alone that we may bcome absolutely independent of foreign influences.

The peculiar property of a vat dye is that the dyestuff as such is insoluble in water and the chemical nature of the dyestuff must be changed before it can be used for dyeing, which is done by the aid of chemicals such as hydrosulphite and caustic soda.

This process is a very difficult one to control and this, no doubt, is one of the principal reasons that vat dyes are not more popular than they are.

As the dyers become more and more acquainted with, and master the method of, application, the vat dyes will become of utmost

importance. In view of this, it is absolutely necessary to protect this group of dyes by suitable legislation.

If such precautions are not taken experts will be sent from the other side in unlimited numbers to better introduce these dyes. Such action will in a measure nullify the intended protection as the vat dyes are liable to replace many of the dyes which are not as fast, which are now made here.

(6) SULPHUR DYES. Sulphur dyes take their name from the fact that a large amount of sulphur enters into their method of manufacture.

Sulphur colors are dyestuffs which are insoluble in water, but, by the addition of sodium sulphide, become soluble in water and are then used exactly like direct dyes on cotton.

The number of shades which can be obtained in this group of dyes is a limited one. This whole group has been exploited by a great many manufacturers in this country and is manufactured in quantities to supply the demand.

Color Lakes (Pigments)

The Color Lake is usually a water soluble acid dye which has been dissolved in water and precipitated by the aid of a mineral salt. After the precipitation, the color is filtered, dried and ground and is ready to be incorporated in oil. The dye is made insoluble in water for the reason that if it were soluble in water it would not be a paint because paints are not supposed to be affected by rain and water. In certain cases similar Lakes are used for printing on fabrics.

The same groups of dyes used for textiles are also employed in the dyeing and coloring of paper, leather and other materials.

In general, *dye for dye, the American products are in every respect equal to their foreign prototypes.*

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DYESTUFF IMPORTATIONS BY GROUPS FISCAL YEAR 1913-1914

Taken from Department of Commerce Reports Special Agents' Series No. 121, by Thos. H. Norton

In a previous description, we have shown the classification of dyestuffs in six groups according to their method of application. The following number of distinct dyes and brands were imported during the fiscal year of 1913-14. We show the classified and unclassified numbers.

	Classified	Unclassified
1. Basic Dyestuffs	804	98
2. Acid Dyestuffs	1,257	530
3. Direct Dyestuffs	929	938
4. Chrome and Alizarin Dyestuffs	429	245
5. Vat Dyestuffs	125	12
6. Sulphur Dyestuffs	269	257
	3,613	2,080

By classified is meant the classification in Schultz and Julius Tables, 1914, generally recognized as the authority on the classification of dyestuffs.

It is understood that under this classification, dyestuffs can be recognized either chemically or technically, which means either by their chemical composition or trade usefulness, which latter after all is the only important factor in a dyestuff.

Under one Schultz number frequently several brands are described or mentioned, and it is taken for granted that the dyestuffs under a given number are suitable for the same purposes if used in the same manner, although chemically they may be different.

By unclassified is meant that the manufacturers and importers were not willing to disclose under what classification the dyestuff belongs, although they were willing to disclose the group. Neither were they willing to disclose the chemical composition of the color, but those unclassified dyes come technically under the same grouping as the classified ones and are used to replace such dyes as given in the classified list. It will be seen by following the six groups described that the number of unclassified dyes was more than half

the classified ones. In one specific instance of direct cotton dyes, the unclassified dyes are *greater* in number than the classified ones, 938 to 929. By analyzing this table it will be seen that while the so-called classified dyes given in Schultz "Tables" are all told 921, there were actually imported in this country in the fiscal year 1913-14, 3,613 classified and 2,080 unclassified dyes, making a total of 5,693.

In order to show how easy it will be for the importer to get around a classification, we have taken a few concrete examples of each group of colors. For instance:

1. BASIC DYESTUFFS

Methyl Violet

This dyestuff is one of the earliest of this group and still finds considerable use in the dyeing and printing of cotton, wool, silk, leather and jute, and in printing ink.

During the fiscal year 1913-14 253,063 pounds of METHYL VIOLET were imported under *eighty-one (81) different names and brands,* and while some of them may have the same chemical composition, many are chemically different. A dyer, however, who is the ultimate consumer of the color, recognizes only a blue shade of violet and a red shade, as he can get any desired effect or shade with these two distinct shades of the dyestuff.

2. ACID DYESTUFFS

(a) Acid Black

This dyestuff is used principally for the dyeing of black on ladies' dress goods, sweater yarn, felt hats, etc.

The most commonly known dyestuff of the series of ACID BLACKS is a dye known under the name:

Naphthol Blue Black

which is either sold and used as a straight dye or mixed with a variety of other dyestuffs, like ACID ORANGE, ACID VIOLET, ACID RED, according to the desired shade which is in vogue from season to season. The following quantities were brought into the country, 726,649 pounds classified, under *eighty-two (82) different names and brands;* 385,051 pounds unclassified, under *fifty (50) different names and brands,* which makes altogether *one hundred and thirty-two (132) different names or brands* for such a simple color as ACID BLACK.

2. (b) Acid Violet

This dyestuff is one of the most important fancy dyes of the ACID GROUP and is used principally in wool dyeing.

It can be safely stated that only one-half a pound of every hundred pounds used is dyed by itself, that is, to produce a violet or purple shade on wool.

It is used mostly as a shading color in combination with other dystuffs of the same or of different groups, where a small difference in the original shade used, can be easily overcome by adding a small amount of the opposite dye, which might be any ACID GREEN having similar dyeing properties, as for instance ACID GREEN or PATENT BLUE (Green Shade).

During the fiscal year of 1913-14, 221,652 pounds of ACID VIOLET were imported under *sixty-six (66) different names or brands,* and while some of them may have the same chemical composition, many are chemically different, each manufacturer having adopted a different method of manufacture to suit the intermediates at his disposal or the convenience of his plant.

3. DIRECT DYESTUFFS

Direct Black

Dyestuffs of this type are consumed in very large quantities for the dyeing of cotton goods of all sorts and cotton and woolen goods (Unions).

During the fiscal year of 1913-14, 2,247,474 pounds of DIRECT BLACK were imported under *one hundred and thirty-seven (137) different names and brands,* some showing the same reaction, the character of others having been disguised by mixing, or they were manufactured by an entirely different method.

Sometimes these mixtures are so well disguised, that even an expert fails to recognize the nature of the dye or the source from which it was produced, but the dyer or user of DIRECT BLACK is usually not interested as long as the dye has the desired dyeing properties.

4. CHROME AND ALIZARIN DYESTUFFS

Chrome Blues

These dyestuffs are principally used for the dyeing of men's wear, piece goods, with silk pencil stripe effects.

During the fiscal year of 1913-14, 303,011 pounds were imported under *thirty-seven (37) different names and brands,* and while few are chemically alike most of them produce the same shades by the afterchrome process, which is the method of dyeing navy blues in pencil stripe cloth.

5. VAT DYESTUFFS

VAT DYESTUFFS are the latest developments in the dyestuff field and their properties as to fastness to washing and light are far superior to all other colors.

During the fiscal year 1913-14, 1,265,056 pounds of VAT DYESTUFFS were imported (outside of INDIGO).

The importance of this class of dyestuff is shown by the fact, that during the fiscal year 1920 (as shown by the report of the United States Department of State, reported by Charles F. Hawes and printed in 1921) import licenses were granted for 1,917,222 pounds of vat dystuffs (outside of INDIGO).

This fact really ought to prove, that although the importations were controlled by the Department of State (War Trade Board) licenses granted for this group of dyestuffs *were for a much greater amount than was actually consumed or imported in the fiscal year 1913-14.*

This proves that the licensing system has not worked a hardship on the consumer of dyestuffs.

Every large foreign dyestuff manufacturer has a line of vat dyestuffs, most all of them chemically different, but the dyes as such not only give practically the same shades but actually possess the same fastness.

The different names under which the foreign houses are marketing products of this series are the following: Algol, Helindone, Indanthrene, Ciba and Cibanone, Hydrone and Durindone.

6. SULPHUR DYESTUFFS

Sulphur Black

The importation of this very important dyestuff during the fiscal year of 1913-14 was 5,122,222 pounds, which was entered into the country under *one hundred and twenty-four (124) different names and brands.* Technically, few SULPHUR BLACKS are of the same chemical composition, but from the dyer's viewpoint this is of no importance as he is interested solely in the principal property of a SULPHUR BLACK, which is its solubility and dyeing quality, and the various brands are substantially alike in these particulars.

As a matter of fact, only a few SULPHUR DYES are of known definite chemical composition.

THESE RECORDS HAVE BEEN COMPILED PRINCIPALLY FROM THE VIEWPOINT OF THE CONSUMER OF DYESTUFFS AS APPLIED TO TEXTILES.

WHY AN ORDINARY TARIFF MEASURE WILL NOT PROPERLY PROTECT THE DYE AND COAL TAR CHEMICAL INDUSTRY

The question has often been asked as to why an ordinary tariff measure will not properly protect the dye industry and why adequate protection during the industry's formative period can be obtained only by an embargo feature, or some other extraordinary tariff measure.

In order to answer this question it would seem necessary to just briefly outline the history and development of the dyestuff industry abroad.

In the first place, let us understand that the dyestuff industry is closely tied up, or as a matter of fact, is part and parcel of the entire coal tar chemical industry, which industry embraces the manufacture of drugs, photographic chemicals, perfumery materials, tanning materials, synthetic resins, and insulating materials, etc. These industries are closely related chemically, are very complicated and very much dependent one on the other.

While the dyestuff industry really originated in England, Germany, realizing the future for this industry, in 1879 started out to capture the world's market in these products.

The Government helped the industry first by passing suitable patent laws and later by more direct methods.

The first stages of development of the organic chemical industry brought about considerable interest to the scientific men of the world. This was especially true in Germany and Switzerland, and as the industry developed, the race for knowledge and achievement became a very serious one. In this race, Germany found it necessary to protect every process, method of manufacture and product.

It is understood that these new chemical bodies or products, aside from arousing scientific interest, also brought a great deal of financial reward to the inventor.

Within the next twelve years after 1879 a great many firms entered into the manufacture of dyestuffs and other coal tar chemicals, and as the saleable products were protected by process patents, it was up to the newcomers in the field to invent new processes for the production of similar products, in order to enter the field. This

forced competitive manufacturers to bring many similar products in the market, therefore new patents were taken out, which not only covered the primary product, but a half a dozen or more similar products or dyes, which were just as useful and produced the same results as the original product.

This was done not for the purpose of bringing a large number of products in the market, but to keep competitors from bringing out substitutes. By this, it will be seen, that it was the race for knowledge and money which actually was responsible for the great chemical development in Germany. In other words, these inventions, while of great scientific interest, actually brought great financial rewards.

As the chemical field is so broad and as the competition became keener and keener every day, eventually the firms combined in order to do away with this idea of duplication. Had they kept it up indefinitely, the result would have been that for every suitable and useful dye there would have been probably fifty to one hundred substitutes, which were just as good as the original dye, as they would produce the same practical results.

After the formation of this original combine, it was not necessary to bring out constant duplication of products, but many processes and products were duplicated by getting out improvement patents and otherwise *in order to keep the rest of the world from going into the dyestuff and coal tar chemical business.*

Today all of the German firms have combined into one large company, known as the I. G. (Interessen Gemeinschaft, which translated, means associated, or pooled, interests).

Therefore today the secret information of each firm is at the disposal of all, to be used for the purpose of controlling the world's business. (See page 38.)

In the statistics of the Department of Commerce, Special Agents' Series No. 121, Importations of Dyestuffs in the Fiscal Year 1913-14, it is shown that in that year, 3,613 brands of dyes were imported, CLASSIFIED AND OF A KNOWN CHEMICAL NATURE, and in addition there were imported 2,080 brands, which were NOT CLASSIFIED AND WERE OF UNKNOWN CHEMICAL CONSTRUCTION, some of which were in part mixtures.

We, in this country, have developed since the war between 350 and 400 of the classified dyes, and Germany in 1913 shipped to this country 5,693 different brands of dyes, while the authority on the subject, SCHULTZ DYESTUFF TABLES, shows but 921 classified dyes.

By reviewing this history it will be easily seen that the Germans can replace the 400 dyes which we are making by several thousand others, which they have made at one time or another. These dyes might differ in chemical composition, but from the practical standpoint of the user, are no different than those made here.

Therefore, if a rate of duty is established for a given dye made here, a similar dye differing slightly in chemical composition but producing exactly the same results, can be brought into this country to replace it.

A table (page 27) shows the compilation of the patents taken out from 1877 to 1902 and the number of separate dyes covered by those patents and also a specimen patent is appended (page 42).

How is one going to fix a rate of duty on a product, which is not being made here, but which will replace one made here?

The classifying of dyes is a very difficult matter as the number is so great. As an example let us take the first twenty-five years of the development of the industry in Germany (1877 to 1902). During that period, according to Friedlander "FORTSCHRITTE DER TEERFARBENFABRIKATION," 4,348 patents were taken out for dyes and intermediates covering approximately six dyes or intermediates for each patent, making in all about twenty-five thousand (25,000) such products covered by these patents.

How is one going to write a tariff bill that will protect the industry against the importation of those dyes which are being made here and also against the importation of dyes, which while chemically different, will do substantially the same work as those made here?

IN OTHER WORDS, IT WOULD WORK OUT IN THIS WAY:

As soon as a tariff bill is passed, which protects only the dyes which are manufactured here, the importer would immediately start to bring over such other dyes as would do substantially the same work and, in view of the number of types at their disposal, it would be an easy matter for them to do so.

In this case, a protective tariff, no matter how high, would not give protection, as it would fail in its purpose; therefore extraordinary measures must be provided.

Not all dyes need extraordinary protection. As a matter of fact, some of the staple products, which are made on a large scale here, can in a great measure be properly protected by high specific

and ad valorem rates, but the industry does not depend upon one or two large manufacturers, and neither does it depend upon the largely consumed staple dyes. On the contrary, the industry depends upon the hundred or more small manufacturers of specialties on a small scale.

It is these specialties which require the highest type and greatest number of technical men for both personal supervision and for research work, and the most complicated machinery and equipment. Therefore, in time of an emergency the manufacturer of specialties is in a much better position to serve the nation with trained men and material.

Therefore, in order to be able to protect this industry it is believed a selective embargo or some other extraordinary tariff measure is needed which would regulate and control the importation of such dyes and other coal tar synthetics as are made in this country in sufficient quantities at reasonable prices and which are of satisfactory quality. Other products, not made here at all, not produced in sufficient quantities, not sold at reasonable prices, or not of suitable quality, *should, in order to safeguard the interests of the consumer, be allowed entry into the United States at reasonable rates of duty.*

Care, however, must be taken to protect the domestic manufacturer, not only against the products which are of the same chemical composition as those made here, but also against foreign dyes which will do substantially the same work as the American product when used in substantially the same manner.

Otherwise the foreign manufacturer will be placed in a position where he will be able to ship here any of the dyestuffs which he has successfully produced during the past forty or fifty years. Aside from that, during the war new materials were brought out in Germany which can now be used for this purpose.

• • • •

Selective Attack

A plan of destroying a competing industry by a method known as "Selective Attack" has been very often used and discussed. The procedure is as simple as the results are disastrous.

In the case of any industry not securely entrenched, such as the coal tar chemical industry in this country, each manufacturer has certain specialties which are comparatively profitable and which serve to carry the less profitable partly developed products until such time as they can stand alone. Plainly, if the manufacturer's market for these specialties is taken away, he will not only be unable to develop the newer products, but he will be actually forced out of the field. *This is especially true in the case of the smaller manufacturers.*

The foreign manufacturer, well entrenched by years of experience, and with a broad line of profitable products, can well afford to temporarily forego a profit on certain few of his products, if thereby competition in his field is removed. Using the method of "Selective Attack," he selects a certain type of dye, or dyes, made by but one or two domestic manufacturers, and which are their specialties. He offers them for sale at a price below domestic production cost. The domestic maker with his props knocked from under him in this manner faces a struggle too great to bear and is forced out of business. *This is especially true of the small manufacturer with limited capital.* One competitor removed from the path of the foreign maker, he repeats this operation against another.

It is said that this plan would not be practicable if adequate tariff protection be afforded every dye made in America.

A perusal of this booklet will show that the foreign producers will not be required to sell below cost the actual product made in this country, but will simply offer similar products of different chemical composition which will do substantially the same work.

Against this open avenue of attack it is very difficult to devise methods of protection, unless all dyes which replace dyes made here, whether or not of the same chemical composition, are accorded the same method of protection.

Prices

Much consideration has been given to the differences of sales prices here and abroad. Little thought, however, has been given to costs of production.

Paradoxically, sales prices abroad, and even here, may be but little controlled by the apparent costs of production. Forty years

of experience on the part of foreign makers has given them opportunity to, and taught them methods of, utilizing all the numerous by-products obtained in the manufacture of coal-tar chemicals. It has been shown that the same intermediates used for the making of dyestuffs, are used for the production of drugs, photographic chemicals, perfume bases, tanning materials, solvents, artificial resins, etc. Hence it happens in many cases, that by-products costing little as such, may be readily converted into valuable products on which there is so considerable a profit as to enable the original product to be sold at a price well below its apparent cost. (For examples see Appendix, page 45.)

But the experience and knowledge necessary for us to make such a numerous progeny of the parent materials we can gain only at the expenditure of considerable capital and great energy, over an appreciable period of time. This, however, we will never be able to do unless during that period we have adequate protection to permit us to expand every branch of the industry. In so far as differences of cost due to low wages and foreign exchange affect this industry ordinary protective tariff measures will adequately protect the industry as these differences of cost become known.

If we think of the dyestuff and coal tar chemical industry in terms of national defense and preparedness, the industry must be preserved to the fullest extent, and the protection of two or three large manufacturers for a time is not going to bring about the desired results.

Thanks to practical knowledge, untiring effort, and personal attention to his business the smaller manufacturer is largely responsible for the development of the synthetic dyestuff and coal tar chemical industry to its present state. It is the smaller manufacturer upon whom will fall the blow. Even now because of the uncertainty of the continuance of the present effective protection (under the Emergency Tariff) it is exceedingly difficult and in many cases impossible for him to procure sufficient finance to continue operations.

It is suggested that a suitable tariff to protect the whole industry would be obtained by adopting Paragraphs 25 and 26 of the Fordney Bill, and the administrative section of the Senate Bill as reported by the Senate Finance Committee in 1920.

While a few minor changes might be necessitated by combining the two, in our opinion the bill would then be effective enough to adequately protect the synthetic coal tar chemical industry in the United States.

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ANALYSIS OF DYESTUFF PATENTS

Patents Described in Friedlaender, "Fortschritte der Teerfarbenfabrikation" 1877 to 1902 (Vol. I to Vol. VI, Inc.)

(This period was the most fruitful in the way of research and development work, especially in the line of extensively used dyestuffs.)

		Total No. of Patents
Vol. I	covering 1877 to 1887.....	432
Vol. II	covering 1887 to 1890.....	358
Vol. III	covering 1890 to 1894.....	619
Vol. IV	covering 1894 to 1897.....	1,138
Vol. V	covering 1897 to 1900.....	880
Vol. VI	covering 1900 to 1902.....	921
		4,348

This total represents not only dyestuff patents, but patents of intermediates and other coal tar chemicals.

Having previously stated that one dyestuff patent represents five or more separate processes or products, as an example we are showing analysis of Volume IV and V of Friedlaender on actual dyestuff patents.

VOLUME IV

	No. of Patents	No. of Processes or Products
Basic Dyestuffs	124	528
Acid Dyestuffs	77	591
Direct Dyestuffs	121	1,267
Alizarin Dyestuffs	51	209
Chrome Dyestuffs	60	280
Sulphur Dyestuffs	3	10
Vat Dyestuffs	1	1
	437	2,886

VOLUME V*

	No. of Patents	No. of Processes or Products
Basic Dyestuffs	46	200
Acid Dyestuffs	62	357
Direct Dyestuffs	59	477
Alizarin Dyestuffs	40	162
Chrome Dyestuffs	20	106
Indigo	4	12
Sulphur Dyestuffs	16	128
	247	1,442

These figures ought to be sufficient to prove that it would be a very difficult undertaking to classify and describe dyestuffs in such a manner as to be able to properly protect the industry by ordinary tariff measures, because on the average each patent covers six dyestuffs,

WHICH, WHILE CHEMICALLY DIFFERENT, WILL DO SUBSTANTIALLY THE SAME WORK, IF USED IN SUBSTANTIALLY THE SAME MANNER.

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*It is interesting to note that even as late as 1900 the development of processes for vat dyes, other than indigo, was in its infancy. Undoubtedly secret research work was being conducted because immediately thereafter patents in increasingly large numbers for this group of dyes were granted.

THE WHITE HOUSE

Washington, August 10, 1921.

Hon. Nicholas Longworth,
House of Representatives, Washington, D. C.

My Dear Congressman Longworth:

I have your note calling my attention to the fact that the bill extending the provisions of the emergency tariff act relating to the protection of the American dye and chemical industry is to be before the House on the morrow. I am aware that the Secretary of the Treasury has already called the attention of your committee to the extreme desirability of extending this protective provision.

Surely we would be both unmindful and unjust if we failed in a suitable protection of this industry until the new and complete tariff revision act is made effective.

Very sincerely,

(Signed) WARREN G. HARDING.

WAR DEPARTMENT
WASHINGTON

July 26, 1921.

Chairman, U. S. Senate Finance Committee,
Senate Office Building,
Washington, D. C.

My Dear Senator Penrose:

My attention has been drawn to the fact that the Fordney Tariff Bill as passed by the House of Representatives will not protect the American organic chemical industry from destruction by German competition.

One of the most startling discoveries of the World War was the fact that the United States could mobilize, train and equip with clothing three or four million men far quicker than it could supply the cannon, the rifles and the ammunition for them. Notwithstanding that from 1914 to 1917 our great steel industries and our rapidly developing chemical industries had been working feverishly to increase their facilities to supply munitions and guns to the Allies, it was more than a year after we entered the war before those industries were able to supply ammunition, war gases, guns and rifles to meet American needs. Even then our chemical industries were so undeveloped in 1917 that it was necessary for the Government to build tremendous high explosive plants as at Nitro, West Virginia, and practically all poisonous gas plants for supplying gases and smoke materials to the United States Army.

Prior to the outbreak of the war in Europe in 1914, the American organic chemical industry was very small. This was particularly true of the dye industry. At that time, the value of coal tar dyes, drugs, etc., produced in Germany was more than twice that produced by all the rest of the world, and more than twenty-one times that of the United States. The dye industry is the backbone of the organic chemical industry on which all Governments are dependent for their high explosives, their war gases, their medicines and many other materials.

So fully did Germany realize before, during and after the World War that predominance in the organic chemical industry and particularly the dye industry meant the most valuable measure of preparedness possible, that she has united all her organic chemical industries into one great trust, the Interessen Gemeinschaft.

Not only is the German workman paid much less than the American workman but the depreciated mark makes the difference still more pronounced. It therefore seems certain that the German dye trust can produce dyes and similar materials so much cheaper than the American can produce them that no ordinary tariff can keep the German dye trust from destroying the American dye industry and thereby crippling the whole organic chemical industry.

The use of high explosives and war gases will unquestionably be far greater in any future struggle than in the World War. Inasmuch as the coal tar industry, which is the base of all dyes, is also the base of all high explosives and most of our war gases, it is of the most vital importance to preparedness that the dye industry be developed to the fullest possible extent in this country. It is felt that this danger is so great that I urge the enactment of the embargo feature of the Fordney Tariff Bill as submitted by the Ways and Means Committee of the House as the only way to prevent crushing our chemical market by German competition.

For the above reasons, England, France, Italy and Japan have already enacted embargoes on the importation of dyes, medicinals and other organic chemicals which will remain in effect for varying periods up to ten years in the case of England.

Very truly yours,
(Signed) JOHN W. WEEKS.

THE SECRETARY OF THE NAVY
WASHINGTON

July 27, 1921.

My Dear Senator:

Understanding that the recommendation of the Ways and Means Committee of the House placing a limited embargo on the importation of coal-tar products (HR7456 General Tariff Revision Page 6) was rejected by the House, I am earnestly requesting that your Committee give special attention to this feature.

The Longworth Bill (HR8078 66th Congress) included a selective embargo regulating the importation of organic chemicals particularly those useful in the preparation of explosives and toxic gases used in chemical warfare.

The Fordney Bill as reported from the Committee included a modified clause to the same effect. It is of great value to the Navy to encourage the development of chemical activities in the manufacture of all products connectcd with the above mentioned articles, especially those manufacturers whose establishments can easily be diverted to the manufacture of war materials when needed. The restoration of the embargo clause will be of material help and I will greatly appreciate your assistance to this effect.

Sincerely yours,
(Signed) EDWIN DENBY.

Hon. Boies Penrose,
United States Senate,
Washington, D. C.

General of the Armies,
Washington, July 15, 1921.

Hon. Nicholas Longworth,
House of Representatives,
Washington, D. C.

Dear Mr. Longworth:

With reference to the protection for the dye industry in this country, it can be stated that the coal-tar products, of which dyes are the most important at present in peace, is the base of practically all of our high explosives and most of our war gases.

Our shortage of chemical plants in general, and dye plants in particular, prior to the World War, made it difficult for us to obtain a supply of high explosives and gases until we had been in the war for several months.

From the above the importance of the chemical industry from a military standpoint will be readily seen.

Sincerely yours,

(Signed) JOHN J. PERSHING.

Extracts from Statement of Brigadier General Amos A. Fries, Chief of the Chemical Warfare Service, U. S. A. Before the Committee on Finance of the U. S. Senate on the Dye and Chemical Schedules of the Tariff Bill, Washington, D. C., Aug. 4, 1921.

General Fries: " * * * All of our war high explosives, most of our war gases, many of our most important medicines and our photographic chemicals, all of which are essential in war, come either directly from these coal tar crudes or in combination with other chemicals. For instance, trinitrotoluol, which is the only explosive now usd in war by any nation, so far as they have a sufficient quantity of it. Before that it was all picric acid, or some compound of it, which comes from the phenol by nitrating.

" * * * Phosgene is another one of our most important war gases. The Germans learned how to make it and use it. They knew how to make it, because they used it directly in making dyes, and it is used in this country now. We have sold a good deal of our surplus phosgene to dye makers.

"In that connection, the first phosgene that was made here was made in a chemical plant at Niagara Falls. They had about the only information, outside of Frank Hemingway who was engaged in chemical production in New Jersey.

" * * * We are interested in the medicine side of this question tremendously, and in photographic chemicals as well as the dyes; but the dyes are the most important in a commercial way. Hence, if that is kept up the others rather follow. In fact, the development of the medicinal parts of these coal tar products followed the development of dyes, even in Germany. * * * "

Senator Calder: "Is it the War Department's desire to maintain and retain that plant?" (The Edgewood Arsenal.)

General Fries: "It is, until such time as we have so completely developed the coal tar industry that we can afford to abandon it. As a matter of fact, today we would have to depend on that plant for a large part of our war gases because we have not the plants

throughout the country and the trained personnel to do it, and even then, if we started those plants, we would have to call on the coal tar industry and other chemical industries for probably three or four or five hundred chemists and chemical workers and chemical operators to put that plant in operation.

" * * * We were also short, in France, of personnel. We could not get trained chemists enough for field use. We have a great deal of use for chemists right out in the field.

"One instance illustrates that clearly. In the fight in which the Marines were engaged at Belleau Woods, a report came back to Corps Headquarters that the Germans were using a new gas and they did not know just what to do. One of the ablest men I had, a chemist, was sent there and rushed into the thickest of the fight, clear through the area, and was able to report to them that it was no new gas; that it was the same gas they had been using and that our gas masks were a protection against it.

"That information was of very great importance to that command and the whole division operating around there. We will need more men of that kind in a future war. We could not get enough of them in France.

" * * * I do not think chloro-picrin had been made to any extent at all. Mustard gas had not.

"It is interesting in connection with the dye question to note that the Germans used one of the ingredients that they finally made mustard gas from in photographic chemical work, allied with coal-tar products, and were able to make mustard gas rather quickly, after they decided to make it, by a method which has been known since 1886. We could not make it by that method, and never did, because we had not developed that part of our photographic or coal tar industry. So we had to introduce an entirely new method developed chemically by Professor William A. Pope of England, who first worked it up, and it was later perfected by Levinstein, a dye manufacturer of England. The process that we are now using is practically the latter's.

" * * * But everyone of these plants that are making dyes or medicines or photographic chemicals or perfumes or any of these other products that come from coal tar can be turned, in a few weeks, into explosive plants. If we have not those plants, then we

have got to build huge plants such as we built during the war; and in the next war we will not have time for it.

" * * * And it was just for that reason in my opinion that she (Germany) was enabled to produce the powders and high explosives and the war gases and her medicine—which are tremendously important in war—on a quantity basis which enabled her to fight that war against the world 4½ years. I do not think there was any other way she could have done it at all.

"Another thing that appeals to me in regard to the embargo was that we are expecting to have a disarmament conference in this country in the next few months. The nations that will interest us most in this conference have already put embargoes on the importation of dyes, and these nations are England, France, Italy and Japan; and looking at it from a preparedness standpoint, it looks to me as if that would be the safest thing for us to try.

" * * * After the battle of the Marne the (German) Government realized the need for expanding the output of explosives and most of the chemical works were producing small quantities by the end of 1914. The demand made on them increased during 1915, but it was not until 1916 that plans were laid down to asist in the enormous production of explosives required by the Hindenburg programme. Most of the big extensions of the synthetic ammonia and of the nitric and sulphuric acid plants date from this time, many chemists being released from the army and the scientific staff of some of the works being augmented. A standard plant used for the manufacture of dyes was converted for the production of explosives with remarkable speed; for instance, at Leverkusen a T. N. T. plant producing 250 tons per month was put into operation in six weeks."

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Extracts from and Synopsis of Article by Dr. A. Buntrock Editor of the "Zeitschrift fuer Farben-Industrie" and German Dyestuff Expert, Published in the "Zeitschrift fuer Farben-Industrie" (Periodical of the Dyestuff Industry) Of January 1st, 1919, Entitled "The Dye Industry of Germany and Other Countries"

"The war is over. The dye industries of the several nations, which by their operations produced one of the most important means for carrying on the war, the explosives, will now place their aid at the disposal of the nations in their friendly struggle to reconstruct the industries which have been hard hit.

"Not only does the textile industry, the largest of the industries of each country, wish back the dyes and chemicals which it requires for the refinement of its finished product, but suffering humanity wants to be in a position to again make use of medicinal preparations for alleviating pain. The agriculturist expects the steady supply of effective fertilizers to improve the produce and yields from his fields. These are to be supplied by the dystuff industry which by its scientific and technical promotion has developed the air nitrogen industry.

"But will the struggle actually be a friendly one?

"Before the war the German synthetic dye industry by far surpassed similar industries of the rest of the world and to such an extent that comparison was simply out of the question. Even the rest of the world acknowledges this fact. True, during the four years of war the industries of France, England and the United States made extraordinary efforts to reach higher levels and, further, they are striving to maintain them and to drive Germany from the field, not only in their own countries, but also in foreign lands.

"That is their good and proper right.

"But the self-evident right of the German dye industry is to prepare proper defensive measures. Peace time only will prove whether the foreign dye industry can survive. Political voices and tariff laws can of course create temporary checks, but eventually dyes will be bought where the best and cheapest are offered without regard to the country of their origin.

"It is much to be desired that the contest shall not assume a phase that retards the understanding among the nations. Understandings of foreign interest more than ever should be widened."

Further on in the article Dr. Buntrock goes into the history of the dyestuff industry in Germany. He says that, although the industry was not born in Germany, it has, thanks to the technical development and due to the adequate supply of chemists for research, reached the position of superiority it occupies today. He furthermore describes the formation of the newly developed monopoly called the Interessen Gemeinschaft, gives the names of the members of this newly formed combine, which are:

Aktien-Gesellschaft fuer Anilin-Fabrikation; Berlin-Treptow.

Badische Anilin & Soda-Fabrik; Ludwigshafen a. Rh.

Farbenfabriken vorm. Friedr. Bayer & Co.; Leverkusen a. Rh.

Leopold Cassella & Co., G. m. b. H.; Frankfurt a. M.

Chemische Fabriken vorm. Weiler-ter Meer.; Uerdingen a. Rh.

Chemische Fabrik Griesheim-Elektron; Frankfurt a. M.

Chemikalienwerk Griesheim, G. m. b. H.; Griesheim a. M.

Farbwerke vorm. Meister Lucius & Bruening. Hoechst a. M.

Farbwerke Muehlheim vorm. A. Leonhardt & Co.; Muehlheim.

Karl Jaeger, G. m. b. H., Duesseldorf.

Kalle & Co., Aktiengesellschaft. Biebrich a. Rh.

Wuelfing, Dahl & Co., Barmen.

"As a result an industry has been assembled which so far as capital is concerned has no equal. Its own capital is about 300 million marks, but if one considers the reserves which do not appear as capital, the united assets of the Interessen Gemeinschaft would amount to one billion marks."

He states that this association places them in the position where they are exchanging processes, the use of patents, etc.

"The manufacturers' processes are to be exchanged. This decision is of great importance. Every one of the mentioned firms has certain specialties in which it has reached the highest standard of achievement. When all those experiences are exchanged the result is that only the best manufacturing methods available in the industry at any time will be employed. It is this fact which will result in placing the German manufacturers of dyestuffs in a position

to produce a quality of goods at such prices that the foreign manufacturers of dyestuffs will be unable to compete. *Tariffs will be of little or no avail.* (Italics ours.)

"It was also voted by the Interessen Gemeinschaft that each product be manufactured in at least two places. This is for the purpose of encouraging further invention and to otherwise improve working methods. This step was taken because the weakest point possible of the Interessen Gemeinschaft is: once the members feel secure from competition they might be willing to sit back and rest on their laurels."

He further states that the future will show how this scheme is going to work out. To make the matter clear, the establishment of this Interessen Gemeinschaft was not effected for glorification, but for the maintenance of leadership of the German dyestuff industry.

He discusses what happened in England, France and Switzerland during the war, *showing that in Switzerland the three largest concerns also combined to safeguard their interests.*

Among other statements he points out that the English Government, in view of the experience of the English dyestuff manufacturers in the earlier years of the war decided to support the industry by loaning it £2,000,000 at 5%, repayable over a period of years. This money was loaned for the purpose of developing additional dyestuffs, installing plants, and for the establishment of research and training laboratories.

He says also that there is practically no industry in Holland and that Italy has invested something like thirty-six million lire in the dyestuff business. He points out the interest that the Japanese Government has taken in this matter in backing up the Japanese industry by guaranteeing an 8% income for ten years.

Finally he discusses the development of the dyestuff industry in the United States and under this heading makes several pertinent statements. He says that the United States believes in mass production and for this reason the dye industry in the United States is not going to be a great success.

He also explains that during the war the United States developed its coal tar products for the purposes of the war which gave it the opportunity to enter into the dye and coal tar chemical field.

He says: "The production of dyestuffs as developed in Germany, necessitates a multitude of small operations, and a willingness to meet the desire of the customers, which often amounts to the making of special brands for the satisfaction of home consumers. This sometimes requires the production of almost minute amount of dyestuffs of special shades or having special properties.

"While the production on a large scale of chemical products may be left to well trained workmen, such as the German industry has trained in the course of years, the development of the smaller production, or rather, the creation of chemicals in a small way, requires an army of chemists, whose task it is not only to use their practical experience, their inventive faculties, but every other means at their disposal, to ensure the undertaking be successfully accomplished. This often requires that the chemist retrace his steps to a consideration of the problem from the viewpoint of pure science * *.

"But this requires money. Money for experimental work and money for investigation, and it is not possible to foretell if it ever can be made to pay." (Italics ours.)

While he does not question that Americans may be willing to put capital into an undertaking under such conditions, he does question whether the attitude of the usual American business man will be favorable to anything but mass production. For that reason Buntrock believes that the American producer will prefer to make 100,000 pounds of one dyestuff rather than 10,000 pounds each of twenty different dyestuffs. The great demand for explosives during the war gave the Americans the opportunity of creating the facilities for large production and therefore some makers are ready to produce dyestuffs and other chemicals on a large scale.

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CONCLUSION

Having considered the facts from the technical point of view of the practical manufacturer, from the viewpoint of safeguarding the security and health of the nation as shown in the letters of President Harding, Secretary of War Weeks, Secretary of the Navy Denby, Chief of Staff General Pershing, Chief of the Chemical Warfare Service General Fries, the reader will be convinced of the peculiar needs of the industry. This conviction must be still more strengthened by the German point of view as shown in the quoted article, and the English sentiment as expressed by Sir William Pope.

Having reached the conclusion that this industry deserves your especial consideration of its peculiar needs, it is your duty to act on that conclusion to the end that the coal tar chemical industry will remain a truly American industry, backed by American capital and manned by American chemists for the benefit of the American people.

SPECIMEN DYESTUFF PATENT

Being German Patent 81573, Issued in Class 22 to
Farbwerke vorm. Meister Lucius & Bruening in Hoechst a. M.
(Dyestuff works, formerly Meister, Lucius & Bruening of Hoechst on the Main.)
Process of Production for the Manufacture of Black Diazo Dyestuffs From Dioxynaphthalene Sulphonic Acids.
This is the Third Addition to Patent 59161 of February 10, 1891
Applied for February 18, 1892
Granted April 29, 1895

(Explanation: In which is granted patent rights to the manufacture of 21 chemically different dyestuffs. To make these 21 dyes one basic intermediate is combined with the other intermediates in such a manner as to make 21 different chemical combinations, all of which give practically the same results.)

SUMMARIZED ABSTRACT

In Patent 59161 was granted rights for the manufacture of certain black diazo dyestuffs made from Dioxynaphthalene Disulfonic Acid. This Dioxynaphthalene Disulfonic Acid is made from the Naphthosulfondisulphonic Acid or the Naphtholtrisulphonic Acid of Patent 56058 by the melting of either of them with alkali. This patent (81573) covers dyestuffs of similar properties and shades as the above, but made in this case from Dioxynaphthalene-monosulphonic Acid S as described in Patent 67829. These dyes (in Patent 67829) are made by combining this Dioxynaphthalene-monosulphonic Acid S with either of two different classes of diazo compounds, in a similar manner to the dyes made according to patents 54116 and 73551. The patent states that no marked degree of difference exists between the dyestuffs produced under this patent, and that the yields obtained are satisfactory, and the dyestuffs themselves are of extraordinary coloring value.

After giving an example of how the dyestuffs can be successfully made, it shows further that under this patent many other intermediates of different chemical composition can be used and in most cases dyestuffs are obtained of the same dyeing properties or which are similar in character.

All of these dyestuffs dye wool in an acid bath from a purple to a deep blue black, which colors, on subsequent after-treatment with chrome salts, produce deeper shades or jet blacks.

Dyestuffs made from Dioxynaphthalene-monosulphonic Acid S under this patent:

	ACID DYED ON WOOL	AFTER CHROMING
1 Mol. diaz. Naphtionic Acid —1 Mol. diaz. Anilin	Blue Black	Coal Black
1 Mol. diaz. Naphtionic Acid —1 Mol. p-Nitranilin	Deep Blue Black	Jet Black
1 Mol. diaz. Naphtionic Acid —1 Mol. diaz. a-Naphtylamin	Blue Black	Jet Black
1 Mol. diaz Naphtionic Acid —1 Mol. diaz B-Naphtylamin	Blue Black	Coal Black
1 Mol diaz Naphtionic Acid —1 Mol. diaz B-Naphtylamin Sulphonic Acid	Blue Black	Jet Black
1 Mol. Naphtionic Acid —1 Mol. diaz B-Naphtylamin Sulphonic Acid G	Violet Black	Coal Black
1 Mol. diaz Naphtionic Acid 1 Mol. diaz b-Naphtylamin Sulphonic Acid R	Blue Black	Jet Coal Black
1 Mol. diaz Naphtionic Acid —1 Mol. diaz Amidonaphtol Sulphonic Acid G (Patent 53076)	Violet Blue	Jet Coal Black
1 Mol. diaz Naphtionic Acid —1 Mol diaz Amidonaphtol Sulphonic Acid R (Patent 53076)	Violet Blue	Jet Black
1 Mol. diaz Naphtionic Acid —1 Mol. diaz Amidonaphtol Disulphonic Acid (Patent 53023)	Violet Blue	Coal Black

1 Mol. diaz Naphtionic Acid —1 Mol. diaz Amidonaphtol Disulphonic Acid H (Patent 69722)	Violet Blue	Coal Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. Anilin	Violet Blue	Jet Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz. p-Nitranilin	Reddish Black	Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz. a-Naphtylamin	Blue Black	Jet Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz. b-Naphtylamin	Blue Black	Jet Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz. b-Naphtylamin Sulphonic Acid	Blue Black	Coal Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz. b-Naphtylamin Sulphonic Acid G	Blue Black	Coal Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz. b-Naphtylamin Sulphonic Acid R	Blue Black	Coal Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz Amidonaphtol Sulphonic Acid R (Patent 53076)	Red Violet	Coal Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz Amidonaphtol Disulphonic Acid (Patent 53023)	Blue Black	Coal Black
1 Mol. diaz. Amidonaphtol Sulphonic Acid G —1 Mol. diaz Amidonaphtol Disulphonic Acid H (Patent 69723)	Violet	Jet Black

IMPORTS AND EXPORTS OF DYESTUFFS BY MONTHS

	Exports		Imports
	1920	1921	1921
January	$917,000	$943,000	297,000
February	1,851,000	397,000	333,000
March	2,649,000	575,000	294,000
April	1,830,000	306,000	279,000
May	2,181,000	278,000	322,000
June	2,389,000	444,000	459,000
July	1,771,000	310,000	838,000
August	1,151,000	.....	.....
September	2,115,000	.....	.....
October	1,802,000	.....	.....
November	2,006,000	.....	.....
December	1,788,000	.....	.....

The table shows at a glance that while the imports by months show a gradual increase, the exports show a gradual but definite decrease. Special attention is called to the month of July, 1921, which is the last month of record, showing imports of $838,000 against exports of $310,000, therefore *the imports are 170% more than the exports, despite the emergency tariff license control.*

Due to Germany's lack of shipping facilities and the necessary selling arrangements the American dyestuff manufacturers have enjoyed a healthy export business. *These figures plainly indicate that our export business is doomed.*

UTILIZATION OF BY-PRODUCTS

By intensive development the coal tar chemical industry has recovered, among others, the following otherwise valueless by-products:

For the manufacture of Paramidophenol, the widely used photographic developer, fur dye, and intermediate for Phenacetin, Phenol is nitrated. This process always yields two products, Paranitrophenol and Orthonitrophenol. While the Paranitrophenol is the raw material for the products named, the by-product, Orthonitrophenol, is used for the manufacture of Guaiacol, one of the few effective tuberculosis remedies, which is also the basis for the manufacture of Vanillin. From Orthonitrophenol is also produced a very effective disinfectant, Chinisol.

In the manufacture of Sulphur Black, the universal and cheapest hosiery black, hyposulphite of soda is obtained as a by-product. This material (the "Hypo" of photography) is used for removing the last traces of chlorine from bleached fabrics, for bleaching wool, straw and oils, and as a preservative in the sugar industry.

In the manufacture of the sweetening substance Saccharine, two pounds of the by-product Paratoluenesulphochloride are obtained for every pound of Saccharine. Valuable use is found for this by-product, however, in the production of Chloramine- and Dichloramine-T, the germicides introduced by Dakin with marked success during the war. It finds further application in the production of an ethylating agent for dye-making, and for the manufacture of a type of acid blues.

Anthracene is the starting-point from which nearly all the remarkably fast vat dyes are made. In the purification of Anthracene numerous other hydrocarbons must be separated as by-products, for example, Carbazol, which is the base of Hydron Blue, a vat dye of great value and fastness, Carbazol Yellow and red and green dyes.

The following list of the application of otherwise valueless by-products might be almost indefinitely prolonged:

The chlorination of Benzol for Monochlorbenzol gives at the same time considerable Dichlorbenzol, which is used as a disinfectant, and as the starting-point for Dichloramine dyes. This type of dyes is very fast to washing.

In the manufacture of Beta Naphthol about 10% of the naphthalene is converted to Alpha Naphthol. Beta Naphthol has various uses as described on page 8. The Alpha compound is used largely for Naphthol Yellow S, and is the basis of other valuable intermediates.

In the manufacture of Gamma Acid, a Naphthalene intermediate, J Acid is a by-product. From Gamma Acid is made Nyanza Black B, Zambesi Brown G, and many other dyes, while from J Acid is made Benzo Fast Scarlet and other dyes. The by-product, J Acid is worth twice as much as the main product, Gamma Acid.

In the manufacture of Peri Acid, another Naphthalene intermediate, Laurent's Acid is a by-product. Peri Acid is the basis for Sulphon Acid Blue R, Coomassie Navy Blue and other acid dyes. From Laurent's Acid is made Brilliant Fast Red G, Benzo Purpurin 6B, and New Patent Blue.

Thus it will be seen that from by-products may be made remarkably diverse substances,—drugs, flavors, disinfectants, and many types of dyes. Many such by-products probably have uses which we have not yet found.

When an organic chemical industry utilizes all its by-products, costs are reduced to a minimum. This development requires time and cannot be accomplished until the complete field of organic chemistry is covered.

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At the Joint Meeting of the American Chemical Society and the Society of the Chemical Industry (British), New York, Sept. 7, 1921, speaking on "Mustard Gas," Sir William Pope, Professor of Chemistry in Cambridge University, said:

"It is customary to suppose that war only exists during a period of hostilities. That has certainly not been the case during the recent conflict. The war from which we have just emerged did not start seven years ago; it started forty years ago, and throughout that whole period you in America and we in England have been fighting for the enemy.

"Every dollar which you spent here on German dyes, every pound which we spent in England upon German dyes, was a contribution toward the military war effort, and although we may have done that in the past in ignorance, I venture to think it will be criminal if you citizens of the United States and we British in the future buy German dyes, which can be made equally well here and in England as in Germany, and so contribute to the German war chest."

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